

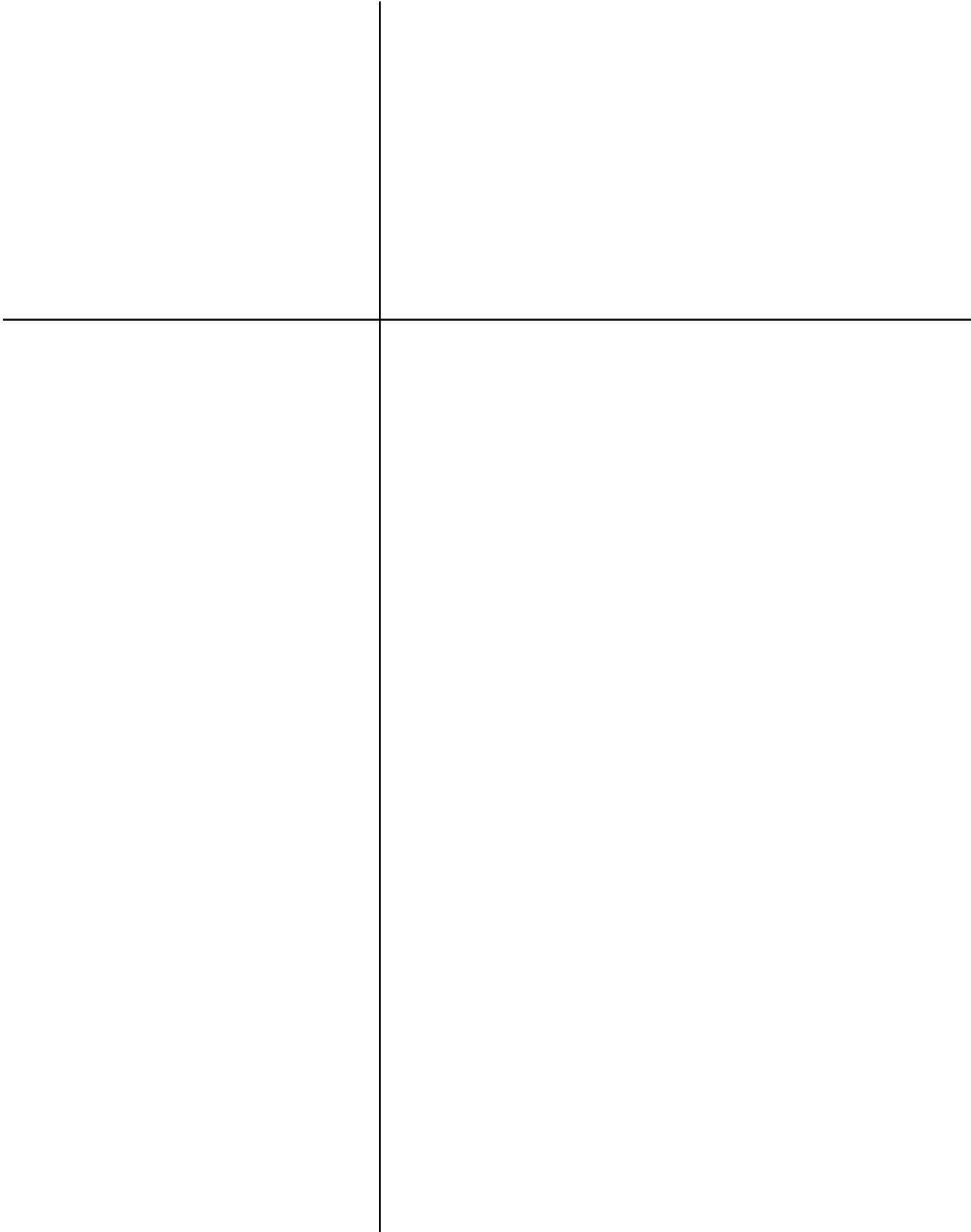
Final
Report

**Commercializing Defense Technologies
and Helping Defense Firms Succeed in
Commercial Markets**

A Report on the Objectives, Activities, and
Accomplishments of the TAP-IN Program

September 1997

TAPIN
A PROGRAM OF THE TRP



Foreword

This report describes the Technology Access for Product Innovation (TAP-IN) program. TAP-IN, funded by the Technology Reinvestment Project, operated from April 1994 until December 1996. TAP-IN was completed under Cooperative Agreement No. NCCW-0041 between the National Aeronautics and Space Administration (NASA) and Battelle Memorial Institute.

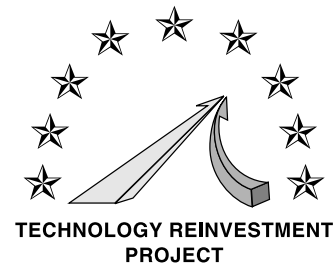
Many people and organizations contributed to the success of TAP-IN. Lee Buchanon, with the Department of Defense's Advanced Research Projects Agency, and Robert Norwood, Director of the Commercial Technology Division (NASA Headquarters), provided leadership and helped set the program's direction. Jonathan Root, Program Executive, managed the project for NASA. Joe Ray, initially, and Chris Coburn, subsequently, directed the project for Battelle. Marianne Clarke served as National Program Manager, and Jeananne Nicholls was responsible for reporting and network development.

NASA's Regional Technology Transfer Center directors made TAP-IN happen in their regions. They included Bill Gasko, Center for Technology Commercialization; Bob Stark, Far West Regional Technology Transfer Center; Chris Coburn, Great Lakes Industrial Technology Center; Lani Hummel, Mid-Atlantic Technology Assistance Center; Gary Sera, Mid-Continent Technology Transfer Center; and Ron Thornton, Southern Technology Applications Center. Numerous staff in the RTTCs and their affiliates contributed to TAP-IN.

Tina McKinley, Chair of the Federal Lab Consortium (FLC),

managed the FLC's involvement in TAP-IN, and Ted Schoenborn, FLC Midwest Coordinator, was responsible for designing and implementing the RIBIT program. Karen Berube, Industrial Designers Society of America (IDSA), helped link TAP-IN clients with IDSA member companies.

This report was written by Marianne Clarke and Monica Crabtree-Reusser.



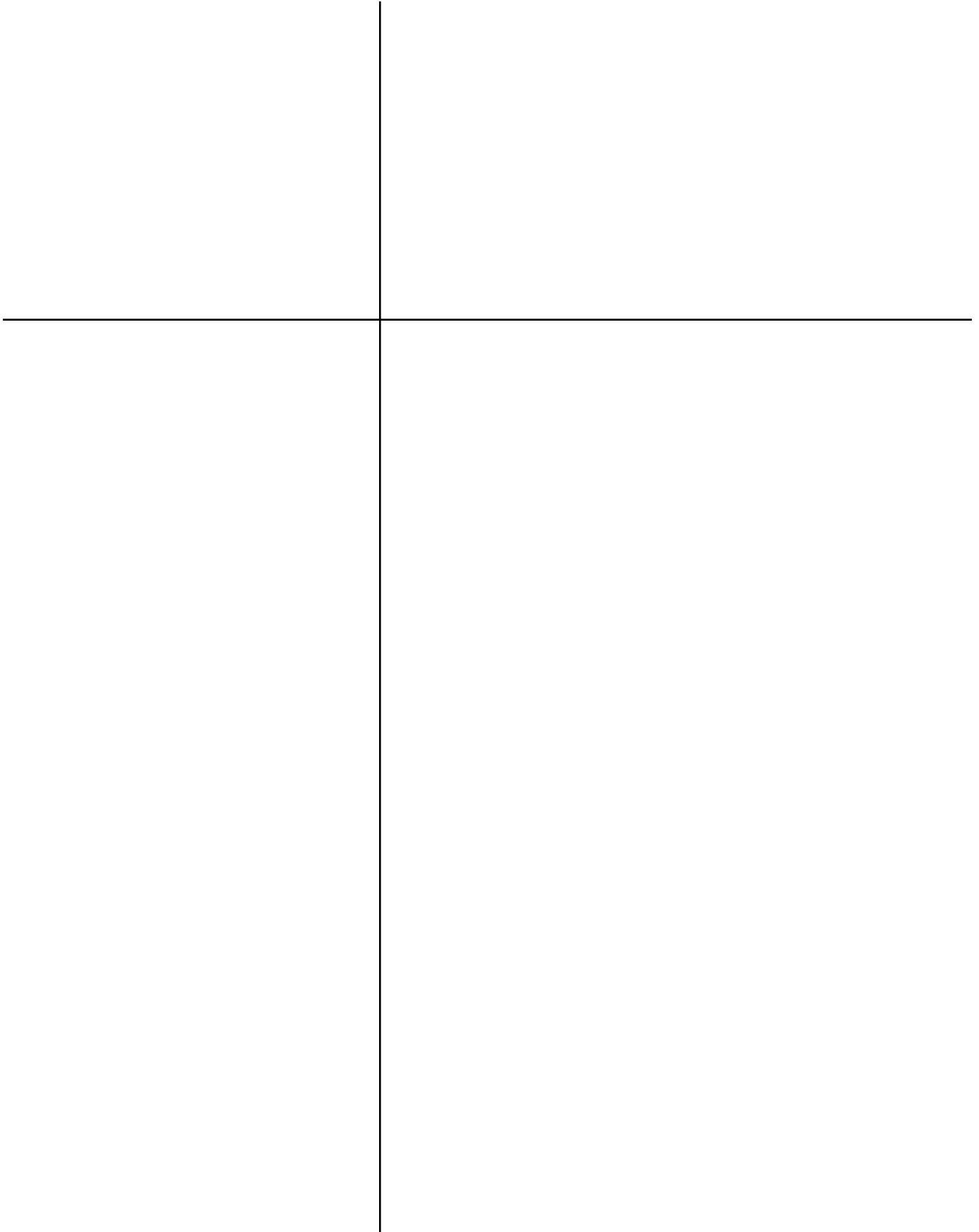
Program Origin

The Technology Reinvestment Project (TRP) was established to “stimulate the transition to a growing, integrated national industrial capability which provides the most advanced, affordable, military systems and the most competitive commercial products.” The objective of the TRP was to develop new technologies, deploy existing technologies in both commercial and military products and processes, and integrate the nation’s military and industrial bases. The TRP program was an unprecedented multi-agency initiative, which included the Advanced Research Projects Agency (ARPA) of the Department of Defense (DoD), the Department of Energy (DOE)/Defense Program, the Department of Commerce’s National Institute of Standards and Technology (NIST), the National Science Foundation (NSF), and the National Aeronautics and Space Administration (NASA). The TRP awarded grants for industrial research and development (R&D) and conducted outreach programs to strengthen the economic competitiveness of defense-dependent firms and increase the availability of dual-use technologies.

“By bringing together the best of our defense and commercial industries, the Technology Reinvestment Project will help ensure that we have the best defense in the world while creating new job opportunities for American workers.”

—President Bill Clinton, October 1993

¹ Program Information Package for Defense Technology Conversion, Reinvestment, and Transition Assistance. Advanced Research Projects Agency, March 1993.





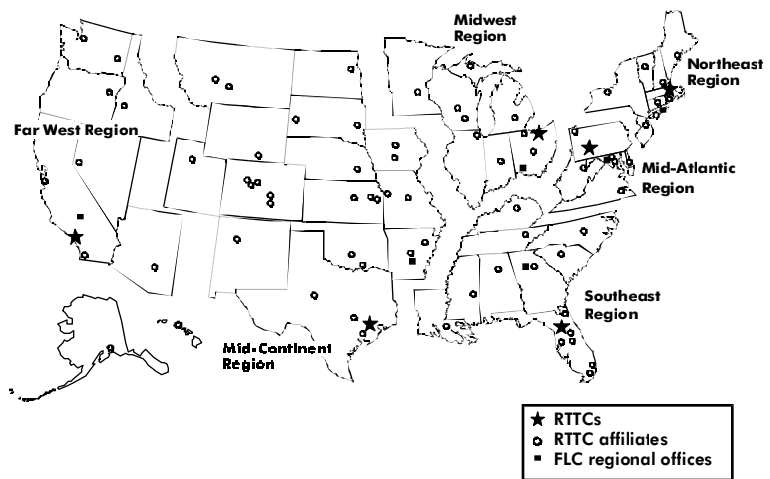
A PROGRAM OF THE TRP

Program Overview

Technology Access for Product Innovation (TAP-IN), the largest technology deployment project funded by TRP, was competitively selected through a national solicitation for proposals. TAP-IN was created to help companies access and apply defense technologies and help defense-dependent companies enter new commercial markets. Defense technologies included technologies developed by DoD, DOE, NASA, and their contractors. TAP-IN was structured to provide region-based technology access services that were able to draw on technology resources nationwide.

TAP-IN provided expert assistance in all stages of the commercialization process from concept through prototype design to capital sourcing and marketing strategy. TAP-IN helped companies locate new technology, identify business partners, secure financing, develop ideas for new products, identify new markets, license technology, solve technical problems, and develop company-specific applications of federal technology.

TAP-IN leveraged NASA's existing commercial technology network to create an integrated national network of organizations that assisted companies in every state. In addition to NASA's six regional technology transfer centers (RTTCs), TAP-IN included business and technology development organizations in every state, the Industrial Designers Society of America, and the Federal Laboratory Consortium (FLC).



The TAP-IN Network

RTTCs

- Provided expert assistance in all aspects of the commercialization process
- Identified defense technologies with commercial application

State Affiliates

- Identified and contacted target companies
- Provided business, financial, and management services

FLC

- Facilitated access to federal laboratory technology and expertise
- Developed and implemented a market assessment program for defense technologies

IDSA

- Provided industrial design services for the conceptualization, design, and development of commercial products

The RTTCs, originally established by NASA to help industry access and use NASA technology, provided unique technology and market assessment capabilities and an affiliate network that included ninety organizations in all fifty states. The RTTCs served as the principal points of entry into the network. The affiliates, which included state agencies responsible for administering cooperative technology programs, manufacturing extension centers, university centers, and local service providers, provided direct assistance to TAP-IN clients and helped match local firms with technology sources nationwide. The FLC, representing more than 600 laboratories, facilitated access to the expertise and technologies of the federal laboratory system. IDSA and its members assisted TAP-IN clients in developing new products for commercial markets.

Overall management of the TAP-IN program was provided by Battelle Memorial Institute, the nation's leading not-for-profit industrial technology organization. NASA managed TAP-IN on behalf of the TRP.

Program Accomplishments

TAP-IN succeeded in achieving its major objectives—commercializing defense technologies and transitioning defense contractors to commercial products. TAP-IN significantly advanced the TRP's goal of establishing an integrated national industrial capability, better prepared to respond to current and future commercial and defense needs.

TAP-IN originally was proposed as a five-year program that would assist 10,000 companies. During its two and a half years of operation, TAP-IN assisted more than 6,000 industry and federal laboratory clients. TAP-IN helped more than 3,000 small defense-related firms seeking to enter new markets and introduce new commercial products and 3,400 clients—including small and large companies, entrepreneurs, and researchers—interested in commercializing defense-related technologies.

TAP-IN succeeded in reaching its target market of small, defense-related firms. A survey of first-year clients showed that 75 percent of TAP-IN clients had fewer than 100 employees.

TAP-IN clients reported a high level of satisfaction with the services provided by the RTTCs. In addition, over 50 percent of those responding to the survey reported that they had taken some action as a result of TAP-IN assistance. Firms also reported cost savings, increases in sales, and the retention and creation of jobs.

Casting Technologies

TAP-IN helped this defense contractor develop a partnership to create an improved casting and machining operation for commercial markets

- 40 percent increase in sales projected

Fonet

TAP-IN helped Fonet launch a new noninvasive cancer detection system. Product introduction is expected by mid-1998, following FDA approval.

- 50 new jobs projected in the first year of manufacture
- Potential market size is \$billions worldwide; Fonet's expected share is \$200 million over next five years.

Meilus Muscular Therapy

TAP-IN helped Meilus launch a new product: a robot arm to assist muscular therapists by applying pressure to muscles just as a therapist would. Eleven units are in service in the U.S. and three have been exported.

- Projected \$10 million in annual sales in U.S. alone.
- 70 new jobs

Rosemount

TAP-IN is helping Rosemount commercialize a NASA technology and develop a sensor to measure temperatures up to 2000F.

- Projected market share is 2 to 3 percent of \$1-billion market

Witter Manufacturing

TAP-IN helped a defense contractor diversify into commercial fiberoptics market

- Market share expected to double
- 12 new jobs

Figure 1.
TAP-IN Exceeded its Goals for Number of Clients Assisted

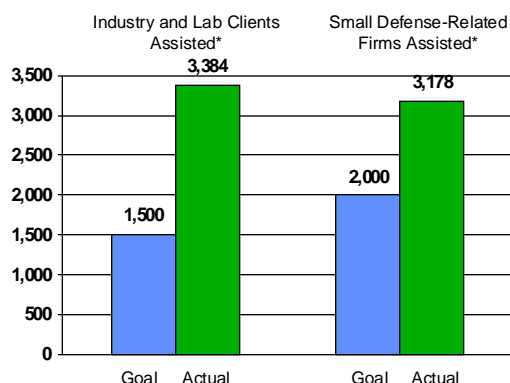
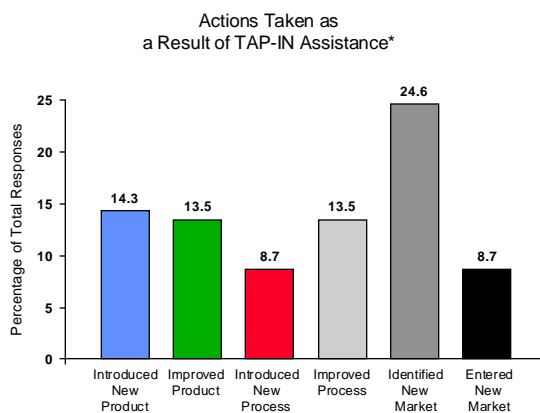


Figure 2.
TAP-IN Helped Companies Improve Their Competitive Position



**based on a survey of first-year clients*

TAP-IN's accomplishments include:

- Commercialization of defense technologies
- Development of technologies with military and commercial applications
- Introduction of technology innovations of importance to the Department of Defense (DoD), NASA, and DOE
- Creation of a national commercialization assistance network based on NASA's commercial technology network
- Stronger private-sector access to federal technology
- Improved process for commercializing technologies developed at federal laboratories

These accomplishments are described in the pages that follow. Stories of TAP-IN successes with individual companies provide illustrations of how TAP-IN achieved its impact.

Commercialization of Defense Technologies

Century Jet

Assistance from TAP-IN is enabling an Ohio aircraft company to bring a military aircraft design to the commercial marketplace. Single-engine jet airplanes are in common use by the military, but none are made for commercial aviation. Century Aerospace is developing a new single-engine business turbo jet that will provide improved performance for substantially less cost than current twin-engine jets. TAP-IN facilitated a cooperative agreement between Century Aerospace and the NASA Lewis Research Center that provided the company with inlet-duct design and icing studies for the new plane.

Century Aerospace had prepared a preliminary design of the *Century Jet*, but needed analyses and testing to proceed with detailed design and subsequent fabrication of a prototype aircraft. TAP-IN linked the company to researchers at NASA Lewis Research Center, and they agreed to a cooperative program for the development of a subsonic, s-duct inlet system for the *Century Jet* business jet. The aircraft has an inlet above the fuselage with an s-duct to the buried engine. Lewis provided initial computational fluid dynamics (CFD) design assistance on the engine inlet and also provided computational fluid dynamics software and training. The CFD analyses were used to identify areas of excessive curvature which would disrupt the airflow and cause the engine to stall. A preliminary look at the results indi-

TAP-IN helped more than 3,000 small defense-dependent companies to integrate defense technologies into commercial products and markets. TAP-IN clients reported approximately \$300 million in average annual sales of new products or processes during the first year of the program. These sales are projected to grow to \$584 million over the next five years. TAP-IN clients reported \$62.7 million in cost savings to date. The actual economic impact of the program will be significantly greater as TAP-IN clients complete the commercialization process during the next 3–5 years.

“Thank you for actually putting into practice the U.S. government philosophy regarding technology transfer. We are sure that the entire general aviation industry joins us in saying: ‘Keep up the good work.’”

—Roy S. Johnston

Vice President and General Manager, Century Aerospace



cated very good inlet performance, and additional calculations, performed with vortex generators installed in the inlet, led to even better results.

Century Aerospace credits TAP-IN assistance with enabling the company to meet its 1997 production goals and expects to create 400 jobs with production of the new jet. A market

study shows that as many as 708 aircraft (at roughly \$1.65 million each) could be sold over a ten-year period.

Phantom Organs

A former weapons facility that has converted 90% of its defense business to medical markets has introduced a new product thanks to TAP-IN assistance. TAP-IN provided instrumental assistance in arranging two CRADAs between the company and two DOE laboratories to develop and produce improved “phantom organs.” Phantom organs are used for diagnostic and therapeutic purposes in nuclear medicine. The company’s improved organs are filled with a radioactive gel instead of liquid solutions. This makes them much safer to work with and more accurate for use in calibrating cameras before they are used on patients. Prototype development and production were accomplished through the CRADA. The company’s phantom organs have been approved, and they are in the registry of field sources of the U.S. Nuclear Regulatory Commission. The company has received an order for \$750,000 of phantom organs.



TAP-IN assistance to Innovation Marine yielded improved marine engines for commercial and military markets.

Development of Technologies with Military and Commercial Applications

Innovation Marine

TAP-IN assisted a small defense-dependent company redesign its marine engines to meet industry standards and produce a more competitive product for defense and commercial markets. Innovation Marine originally approached the RTTC to benchmark its products and operations. Through an RTTC assessment the company discovered that its marine engines would have to be redesigned to meet noise and emissions standards that had recently been proposed for the recreational boating industry and the Navy. The company did not have the design capability in house. Sources of technology for emissions and noise control are few and generally only found in large companies. The RTTC linked the company to a university with equipment and expertise in this area. (Queen's University in Belfast, Northern Ireland) and a federal laboratory with expertise in noise data. (Los Alamos National Laboratory). The RTTC facilitated a sponsored research project in which the partners redesigned the intake and exhaust systems of the company's engines. The engines now meet the proposed standards, and their overall performance has been improved as well. The Naval Special Warfare Development Group conducted tests of the engine design and placed an order for \$3 million worth of engines. The company also developed a model for high-performance sport boats. Sales forecasts for this engine are very promising.

The TAP-IN program demonstrated the feasibility of developing technology with dual-use applications. By forging partnerships between technology companies and researchers in defense laboratories, TAP-IN clients succeeded in introducing products for use by both commercial and defense customers, in some cases reducing development and/or production costs for each partner. TAP-IN facilitated 137 licenses or partnerships between federal labs and commercial ventures to acquire and apply new technology.

JohnCo—MAC Kit

TAP-IN helped a small New York company identify and access a Navy technology and develop a new commercial product to quickly detect the presence of illicit drugs. JohnCo, located on the Seneca Nation Reservation, asked for assistance in locating recently developed technologies that it could develop into a new industry that would provide jobs for the youth of the reservation. TAP-IN identified a promising technology from the Naval Research Laboratory (NRL), facilitated its acquisition, and linked JohnCo to numerous organizations that provided a range of critical contributions.

The technology, Microassay on a Card (MAC), was developed by NRL for military police and customs officials. TAP-IN helped JohnCo obtain a license to develop, manufacture, and market the technology as a drug-detection device. TAP-IN facilitated commercialization by identifying development partners. The Biochemistry Department at Georgetown University refined some of the biochemical processes that will be used in manufacturing the product. Cellular Products, Inc., a fully integrated biotechnology company, will conduct additional biotechnical development and will provide the appropriate antibody components during production. Tanaka Kapec Group, Inc., (TKG) an IDSA member, created card designs, product instructions, and user-friendly packaging tailored to the law enforcement market. The JohnCo product is a unique laminated card that can be easily mass produced.

Pnu-Light

TAP-IN helped Pnu-Light Tools turn its pneumatically powered light prototype into a successful product. The company's light was powered by a miniature motor that used air pressure diverted from the pneumatic lines. The company wanted to develop the light into a product that would retrofit onto a variety of pneumatic tools and illuminate manufacturing and assembly processes, enabling workers to see in areas that escape the glow of traditional lighting.

A TAP-IN state affiliate facilitated a cooperative project with the DOE's Kansas City Plant (KCP) for the company. KCP evaluated components, tested them, and produced improved prototype parts. The affiliate also helped the company conduct market studies and determine business strategies.

Pnu-Light has succeeded in launching its product. GM now uses the light to assemble automobile axles, dashboards, and gas tanks. The Navy, Army, Air Force, and Coast Guard all buy the Pnu-Light add-on. Sales have reached \$150,000, and a Colorado company has signed a nonexclusive license agreement, paying \$560,000, for the add-on. Pnu-light is now developing tools with the light built in.



The Pnu-Light retrofits onto pneumatically powered tools and provides light—right where the worker needs to see.

Introduction of Technology Innovations of Importance to the Department of Defense (DoD), NASA, and DOE

TAP-IN projects led to important technology innovations for DoD, NASA, and DOE. These include: designed-in radiation-tolerant microchip technology that can significantly reduce cost to dual-use satellites and other systems facing potential radiation threats; a new concept for creating fault-tolerant computers; a computer memory device to replace tape-drive flight data recorders; new low-cost field emission flat panel display technology with wide-spread dual-use applications; and development of a packaged infrared imaging system for field and combat medical applications.

Radiation-Tolerant Microchip

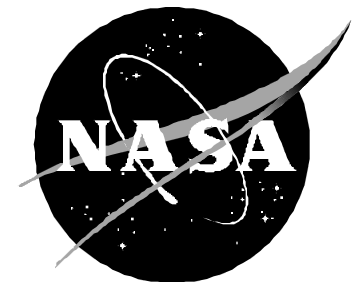
An RTTC is commercializing a technology, developed at the NASA Institute of Advanced Microelectronics, that will soon provide DoD, NASA, other government agencies, and industry with radiation-tolerant microchips at a fraction of the current cost. The radiation-resistant microchips required for defense and space applications are currently manufactured differently than commercial chips (using heavier metals or expensive radiation-resistant materials, for example). These special chips must be fabricated in dedicated “radiation-hard” foundries, using completely different techniques and equipment than commercial foundries.

The NASA technology achieves radiation tolerance by incorporating redundancies into the design of the chip, as opposed to altering the manufacturing process. The biggest advantage of this technology is that commercial foundries will be able to use their existing equipment to produce radiation-tolerant, space-qualified chips. Radiation-tolerant chips will be much less expensive because the foundries’ capital costs will be distributed over quantities of both commercial and radiation-tolerant chips. These costs are staggering—\$1.5 billion per foundry every five years. (Reinvestment is required approximately every five years to accommodate advances in microchip technology.)

In addition to the cost savings, the new technology will enable DoD, NASA, and other government agencies to incorporate technological advances in microchip manufacturing (smaller,

cheaper, faster electronics) into government programs as they occur in commercial foundries. Foundries dedicated to radiation-hard electronics lack the volume necessary to justify rebuilding at a rate that keeps up with the technological changes occurring in the commercial electronics industry.

The RTTC was instrumental in winning acceptance of the technology within the defense and commercial sectors and in establishing the foundation for its commercial use. The RTTC has provided ongoing assistance to a consortium of private corporations and government agencies which is dedicated to commercializing the technology. Members include NASA Goddard Space Flight Center, NASA Headquarters, TRW, Aerospace Corporation, Virtual Silicon Technology, Inc., NASA Institute of Microelectronics (located at the University of New Mexico), NASA Jet Propulsion Laboratory, NASA Johnson Manned Space Flight Center, and Center for Technology Commercialization, Inc., NASA's northeast RTTC. The RTTC facilitated negotiations for an exclusive license of the technology between the University of New Mexico and Virtual Silicon Technology, the leading supplier of semiconductor library technology for microchip foundries. The exclusive license with Virtual Silicon will allow all interested industry and federal agency users access to the technology through many foundries.



Medical Thermal Diagnostics

An RTTC state affiliate provided assistance to Medical Thermal Diagnostics to help it win a \$750,000 Small Business Innovation Research (SBIR) grant from the Department of Defense and prepare to commercialize its technology. Medical Thermal Diagnostics is developing an infrared imaging system for defense and commercial markets. The system detects heat generated by the body and translates it into an image on a head-mounted monitor. Patients can be seen in total darkness. Military medical teams wearing the imaging system will be able to locate, assess, and stabilize wounded personnel in the dark or under limited-visibility conditions. The RTTC affiliate provided SBIR proposal development guidance, commercial assessment of the product, and links to appropriate laboratories for technical assistance.

Creation of a National Commercialization Assistance Network

Advanced Research Corporation

TAP-IN helped the Advanced Research Corporation (ARC) develop and market a new commercial product that capitalizes on the Global Positioning Satellite (GPS) system developed by the Department of Defense. The company's Star Watch Allocation System tracks and reports the position of valuable assets. Objects are fitted with a device that computes current location by referencing off the GPS satellites. The device transmits the location through a cellular network or another satellite system to a central location. The information is then relayed to the consumer's computer screen.

TAP-IN provided ARC with numerous contacts that contributed to the development of the final product. A TAP-IN state affiliate helped the company locate an expert to cowrite the computer program that allows consumers to see the location of their assets on a laptop computer. The affiliate also linked the company to an attorney who consulted on legal issues. The Colorado Advanced Technology Institute was enlisted to assist the affiliate with technical, business, and marketing assistance. Technology Associates of Colorado referred the company to the TAP-IN affiliate and provided help with business plan development and marketing assessments.

The Star Watch Allocation System hit the market in November 1995.

The TAP-IN program created a national network to support the development of an integrated military/commercial industrial base. TAP-IN built upon NASA's existing RTTC organization and transformed it into a truly unified commercialization assistance network. The RTTCs formed partnerships with numerous TRP-funded programs and projects as well as with the Manufacturing Extension Partnership system. Such partnerships provided defense-dependent companies with access to an enhanced network of service provider organizations. TAP-IN also enabled the RTTCs to form working partnerships with DoD and DOE laboratories across the country.

Stronger Private-Sector Access to Federal Technology

TAP-IN introduced 95,000 small defense companies to the wealth of technologies and expertise resident in the federal laboratory system and made more than 150,000 lab and industry clients aware of opportunities for commercializing defense technologies. In addition, DoD and DOE laboratories became familiar with the RTTC network, its ability to know industry and understand its needs, and as a resource to quickly disseminate information and thoroughly evaluate technology for its commercial marketability. The RTTCs continue to facilitate interactions between these clients and the federal laboratory system.

CACTIS MultiPro®

The RTTC provided access to technologies and links to expertise that enabled a defense contractor to launch a new commercial product. The Cactis MultiPro® is a portable speaker's podium loaded with equipment that allows enhanced multimedia and interactive activities in presentations. The MultiPro can incorporate preplanned or real-time audio and video effects, provide presentation control from anywhere in the room, print handouts or send them electronically to any device on an existing network, and receive, record, and analyze immediate feedback from the audience. The podium houses a CPU tower, a CD-ROM, a laser videodisc player, a VCR, a wireless mouse and microphone, a laser printer, an embedded CACTIS wireless response system, a wireless bar-code scanner, high fidelity speakers, and a laser pointer.

The CACTIS MultiPro® might never have made it to market without the assistance of TAP-IN. Consulting Associates, Inc., was attempting to develop its concept for the MultiPro into a prototype. A few technical challenges were preventing the creation of a fully operable product. Radio frequency interference from the many devices housed within the podium was an issue as were the various antenna patterns and frequency flows. The company contacted Virginia's Center for Innovative Technology for assistance. The center, an RTTC affiliate,

referred the company to the RTTC. The RTTC partnered the company with NASA Langley to license and develop three technologies that resolved the technical problems and helped make the Cactis MultiPro® the revolutionary product it is. These technologies were used in the design of the specialized computer that coordinates all podium functions, the engineering of the antenna placement to shield interference, and the response pad that receives audience input.

The podium made its national debut on February 6, 1996, at the meeting of the National Press Club in Washington, DC. Its development was cited by the National Association of Management and Technology Applications Centers and awarded its technology transfer "Project of the Year." The podium has been chosen as the delivery system for multimedia programming for the Natural Partners Classroom of the Future Program at the Smithsonian. The company is installing Cactis MultiPro® equipment at the University of Virginia and NASA.



The Cactis Multipro® podium enables enhanced multimedia and interactive activities in presentations.

KVH

TAP-IN assisted a formerly defense-dependent Rhode Island company to access and acquire a NASA technology that the company is developing into a major new commercial product. KVH Industries was trying to develop a new communications system that would deliver direct TV to land-based moving vehicles. The company was already in the business of providing TV to ships. Its system used a special antenna to lock onto and receive TV from an orbiting satellite. But the antenna would not work with land-based vehicles because they move differently than ships at sea. TAP-IN helped the company identify a NASA JPL antenna suitable for KVH's needs. The antenna was stabilized so that it could continuously track a satellite even if the antenna were moving, and it transmitted and received signals simultaneously. TAP-IN also helped the company negotiate a license with JPL for the technology and linked KVH with the JPL Affiliates Program. Through the program, JPL engineers modified the antenna for the direct broadcast frequency range. The company credits new product opportunities with the creation of 100 new jobs.

Improved Process for Commercializing Technologies Developed at Federal Laboratories

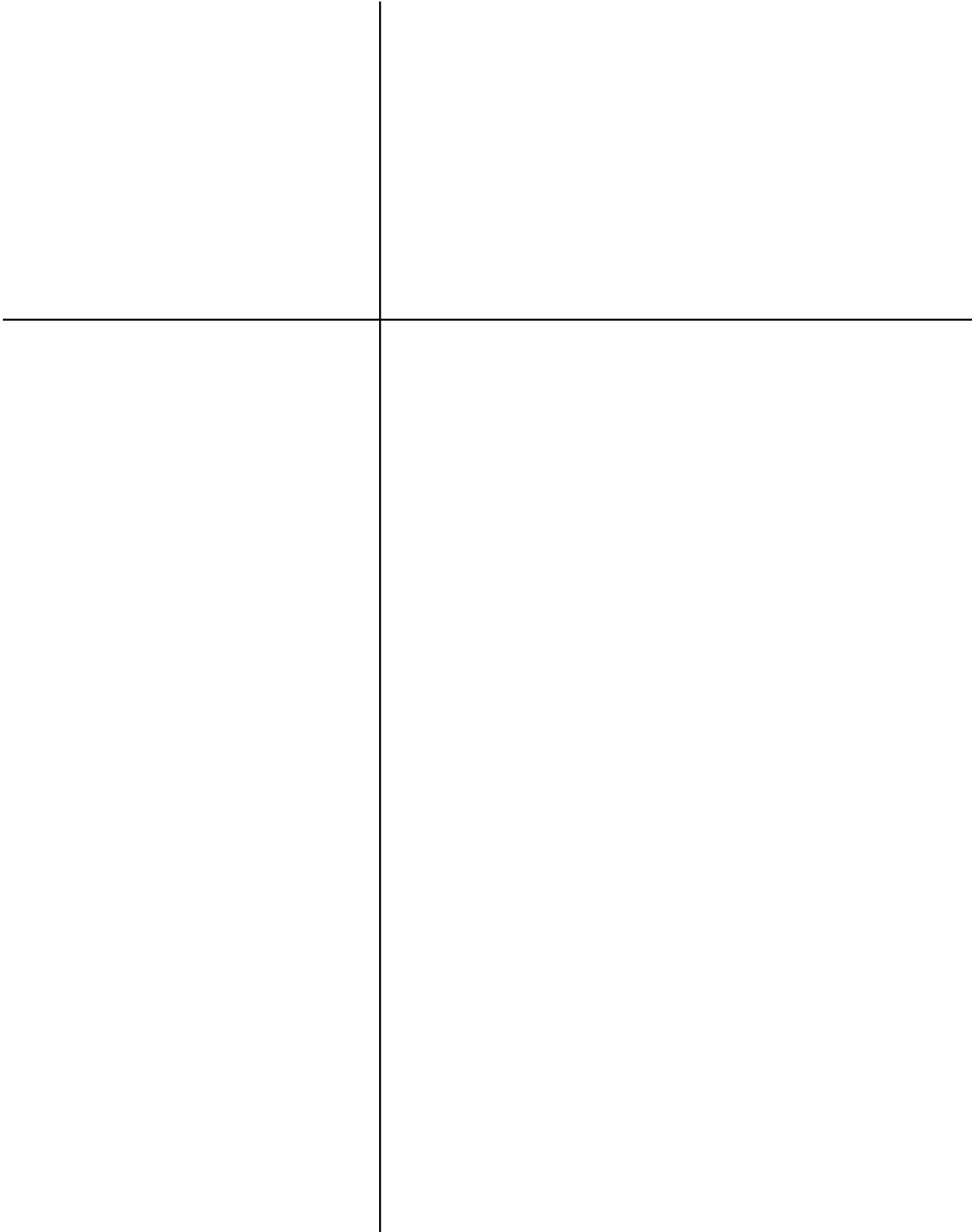
From Lab to Market: RIBIT

The Reinvention Initiative Between Industry and Technology (RIBIT) program was established to identify federal technologies with commercial potential and facilitate partnerships to move technologies from the lab to the marketplace. RIBIT is a joint undertaking of the Federal Lab Consortium (FLC) and the six RTTCs.

The program began under TAP-IN and initially focused on defense technologies. In the first round, federal labs across the country nominated more than 400 technologies believed to have commercial potential. Market assessment analysts from the RTTCs reviewed each technology and selected more than 100 to evaluate in greater depth. The team then selected the twelve most promising technologies for a focused commercialization effort.

The RIBIT program partnered the vast wealth of technological resources in the federal lab system with the in-depth knowledge of commercial markets and the commercialization process resident within the RTTC system. TAP-IN has been instrumental in developing a process for drawing the technologies out of labs and government agencies, singling out the strongest, and laying the foundation for their commercial development.

The RTTCs collaborated with the Federal Laboratory Consortium to develop and implement a process for performing commercial assessments of defense technology. The program, Reinvention Initiative Between Industry and Technology (RIBIT), provided market information on defense technologies critical to their successful commercial development. A second round of the RIBIT program is planned. Funding has been secured from the FLC and additional funds are being sought from the DoD.



Program Resources

TAP-IN was a \$42 million program that operated from April 1994 through December 1996. As originally envisioned, TAP-IN funds extensively leveraged existing resources. The NASA RTTCs, their affiliates, the FLC, and individual states contributed more than \$27 million in cash and in-kind contributions. TRP provided another \$15.5 million. TAP-IN not only met but significantly exceeded its required cost share. TAP-IN successfully increased matching funds as TRP funding declined.

Figure 3.
TAP-IN Delivered Greater Impact
by Leveraging Existing Resources

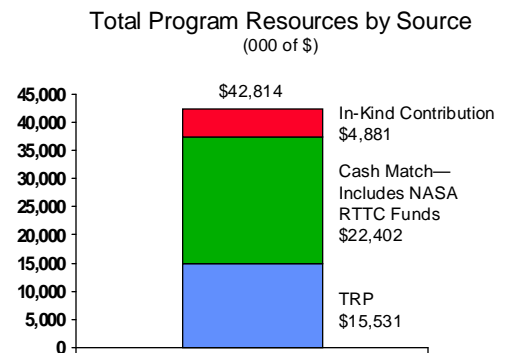
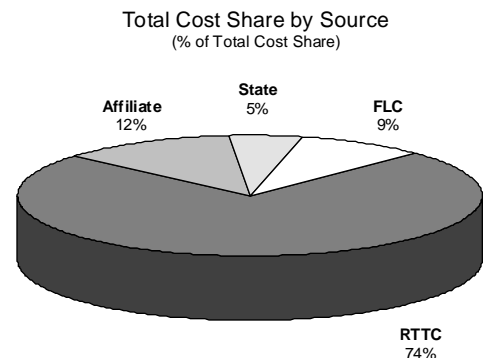
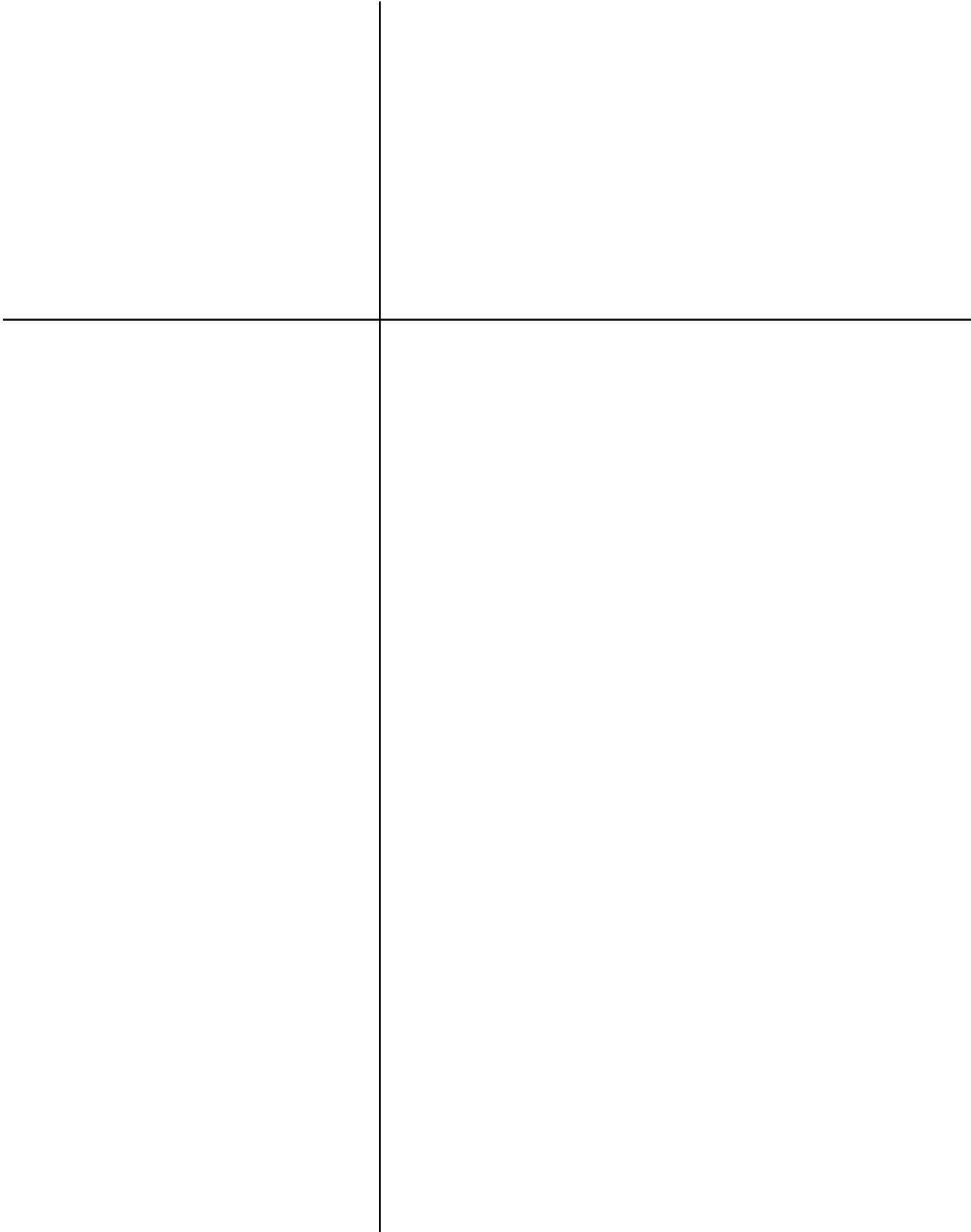


Figure 4.
Partners Contributed \$27 Million in Cost
Share—64% of TAP-IN's Total Budget





TAP-IN Services

TAP-IN services focused on product diversification and associated technology, market planning, and financial planning requirements. TAP-IN provided three categories of services—technology, commercialization, and information.

Technology Services

- Identifying product opportunities that fit a company's technological and production capabilities
- Identifying alternative applications for existing processes
- Defining required technology and expertise needed to pursue specific opportunities
- Accessing and facilitating technology and engineering-related assistance

Commercialization Services

- Assessing market potential of new products or current products in new markets
- Assessing financial requirements and locating sources of state or local financial assistance
- Identifying technology and expertise that provided best match for specific needs
- Facilitating the acquisition of technology

Information Services

- Identifying and locating facilities, technology, and expertise through database searches and networking.

Figure 5. TAP-IN Services Helped Companies Expand Beyond Defense Markets or Use Defense Technology to Improve Their Competitive Position

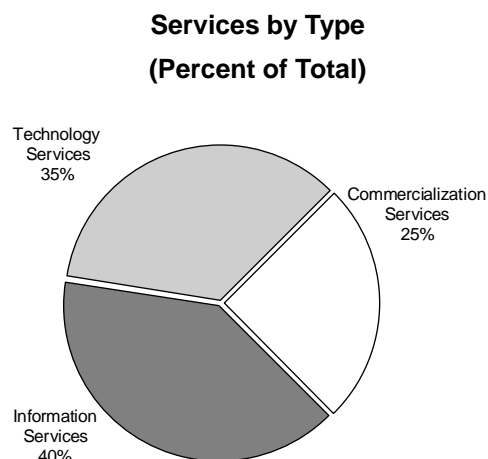
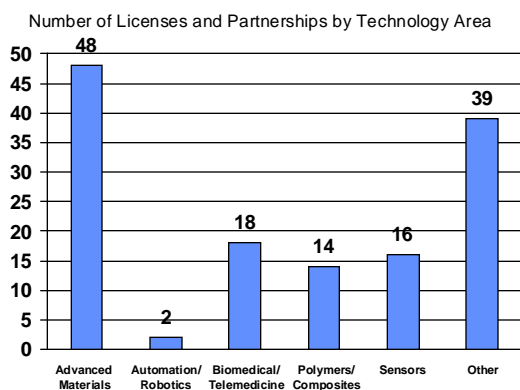
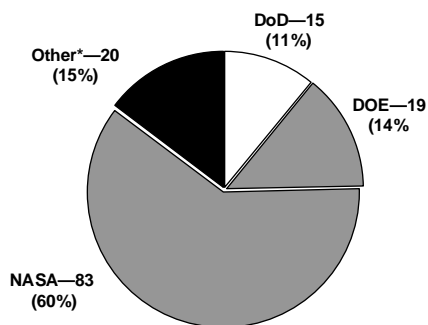


Figure 6.
Industry Obtained Broad Access to
Federal Technology Through TAP-IN



**Refers to private and university-based laboratories and technologies.*

Number of Licenses and Partnerships by Organization



**Refers to private and university-based laboratories and technologies.*

RTTC staff delivered services directly or referred clients to other network participants. For example, TAP-IN helped clients negotiate 137 licenses and partnerships to acquire and apply new technology. One-third were executed in advanced materials and the rest in numerous fields. Figure 6 shows the distribution across technologies and by laboratory. Approximately 60 percent of the licenses and partnerships were executed with NASA centers.

Conclusion

TAP-IN was established to help companies commercialize defense technologies and to help defense contractors compete in commercial markets. TAP-IN succeeded in accomplishing these objectives in spite of many obstacles encountered and the short duration of the program. TAP-IN helped more than 3,000 small defense firms enter new markets and introduce new commercial products and assisted more than 3,400 industry and laboratory clients in commercializing defense-related technologies during its two and one-half years of operation. The actual economic impact of the program is difficult to measure and is yet to be realized. Many of TAP-IN's client companies are still completing the commercialization process begun under TAP-IN and will introduce and market new products and services in the near future. Typically, this will take another 3–5 years.

TAP-IN confirmed that small, defense-dependent companies often need business, technology, and financial assistance to enter commercial markets and remain competitive. Many defense-dependent companies have a weak understanding of the commercial market and limited capabilities to operate in it. They are often unfamiliar with marketing, market assessments, and the differing financial and cash management requirements of a commercial products business. A major restructuring of the organization is often necessary to fully realize commercial success. Lastly, adapting a defense technology to a commercially user-friendly

product can require an immense effort, and small defense contractors often lack the financial resources needed to accomplish it.

TAP-IN also uncovered serious obstacles to commercializing federal defense technology. First, the process by which commercially viable federal technologies are identified needs to be improved. Often the RTTCs were unable to find companies interested in licensing technologies that laboratory personnel believed to be ready for commercialization because the technology was too unproven or the estimated market was too small. Researchers, technology transfer officers, and intellectual property managers within the laboratories need a better understanding of industry needs and requirements of successful commercialization.

Second, commercialization-related considerations must be incorporated into the initial stages of technology development projects. While the mission-specific goals of technology development are a priority, decisions can be made in the early design stages that will enhance the technology's potential commercial development over the long term. Such decisions can have enormous impact on the cost of manufacture for commercial markets as well as on the capability of attracting commercial development partners.

The TAP-IN program has ended, but its impact will be long term. TAP-IN created partnerships that will last long beyond the end of the program. First and foremost, the RTTCs created ongoing relationships with DoD and DOE laboratories and facilities throughout the country and with both large and small defense contractors. The RTTCs and the FLC are implementing a program to facilitate the transfer of federal technology to the commercial market. The RIBIT program is expected to improve the identification process of marketable federal technologies. Links were made to numerous state and local organizations that will be a continuing resource for the RTTC network. Partnerships facilitated by TAP-IN among firms and between firms and federal laboratories will continue to bear fruit.

Industry's ability to develop technologies with application for both defense and commercial markets is key to meeting the nation's future defense needs. This requires that U.S. industry stay on the cutting edge of technology and that communication between federal laboratories and industry increases significantly. TAP-IN made a significant contribution toward maintaining the competitiveness of American companies by assisting defense firms to expand their commercial markets and nondefense and defense firms to incorporate advanced technology into their products and operations. TAP-IN has laid the foundation for future productive industry-laboratory relationships and projects.

Lastly, the success stories described in this report clearly indicate that TAP-IN made a significant contribution to both the economy and to the competitiveness of individual companies. TAP-IN clients reported increased sales and revenue and the creation of new jobs. The long-term economic impact will continue as these firms and other TAP-IN clients complete the commercialization process.

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